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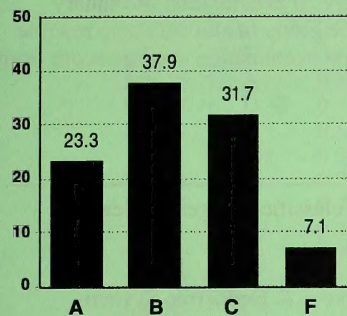


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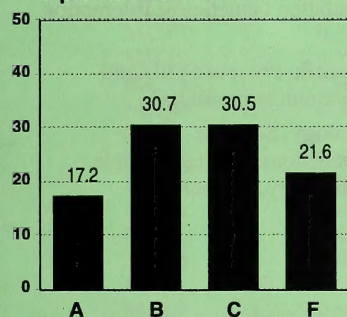
Biology 30

Diploma Examination Results Examiners' Report for January 1996

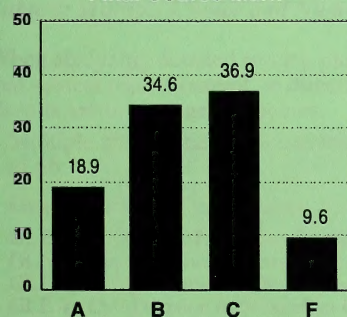
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1996 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 examination consists of 48 multiple-choice questions worth 60%, 8 numerical-response questions worth 10%, and 2 written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 7 670 students in Alberta who wrote the January 1996 examination. This represents a decrease of 92 students compared with January 1995, and a decrease of 869 students compared with January 1994.

- 90.4% of the 7 670 students achieved the acceptable standard (a final course mark of 50% or higher).
- 18.9% of the 7 670 students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was very good. The percentage of students who achieved the acceptable standard (90.4%) was nearly identical to the percentage for January 1995 (90.7%). Most students demonstrated a very good understanding of population genetics, how populations interact with their environment, and human reproductive systems and how they are regulated. They demonstrated a good understanding of differentiation, development, and molecular genetics. Some students had difficulty with concepts related to the nervous and endocrine systems, cell division, and Mendelian genetics. The majority of students were able to describe and evaluate scientific research procedures very well.

Approximately 58.4% of the students who wrote the examination were female. Of this female population, approximately 78.4% achieved the acceptable standard on the examination, compared with 78.2% of the male population. The standard of excellence was achieved by approximately 16.9% of this female population, compared with 17.6% of the male population.

Provincial Averages

- The average school-awarded mark was 68.3%.
- The average diploma examination mark was 63.0%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 66.0%.

Approximately 10.1% of the students who wrote the examination in January 1996 and received a school-

awarded mark had written at least one other Biology 30 Diploma Examination during the January 1994 to January 1995 period. This subpopulation (778) achieved an examination average of 58.3%, compared with 63.5% for the population (6 892) who first wrote a Biology 30 examination in January 1996. However, the group of students who rewrote (835) increased their examination average score from 48.9% to 58.3%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations.

Knowledge:

- GLE 1 Nervous & Endocrine Systems
- GLE 2 Reproductive Systems & Hormones
- GLE 3 Differentiation & Development
- GLE 4 Cell Division & Mendelian Genetics
- GLE 5 Molecular Genetics
- GLE 6 Population Genetics & Interaction

Skills:

- SPSC Scientific Process Skills and Communication Skills

Science, Technology, Society:

- STS Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC1	B	0.824	✓							
MC2	C	0.771	✓							
MC3	D	0.539	✓							
MC4	B	0.578	✓							✓
MC5	A	0.746	✓							✓
MC6	B	0.457	✓							✓
MC7	C	0.676	✓							
MC8	D	0.733	✓							
MC9	B	0.721	✓							
MC10	C	0.677	✓							
MC11	B	0.558	✓							
MC12	A	0.605	✓							✓
MC13	B	0.547	✓							✓
MC14	D	0.589	✓							
MC15	B	0.622	✓							✓
NR1	5718	0.527		✓						✓
MC16	A	0.558		✓						✓
MC17	D	0.764		✓						
NR2	2467	0.670		✓						

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC18	A	0.646		✓						
MC19	C	0.573		✓					✓	
MC20	C	0.442			✓					
MC21	B	0.536			✓					
MC22	A	0.811		✓						✓
MC23	D	0.559			✓					✓
MC24	D	0.551			✓					
MC25	B	0.783			✓					
NR3	2314	0.639			✓					
MC26	A	0.745			✓					✓
MC27	D	0.571				✓			✓	
MC28	B	0.695				✓			✓	
NR4	4231	0.521				✓				
MC29	B	0.717						✓		
MC30	C	0.706						✓		
NR5	150	0.732						✓	✓	
MC31	D	0.755						✓		
MC32	A	0.488						✓	✓	
MC33	C	0.787						✓	✓	
NR6	2453	0.554						✓	✓	
MC34	A	0.853				✓			✓	
NR7	0.25	0.709				✓			✓	
MC35	C	0.837				✓			✓	
MC36	A	0.389				✓			✓	
MC37	D	0.345				✓			✓	
MC38	B	0.756				✓			✓	
MC39	C	0.608	✓							
MC40	B	0.385	✓							
MC41	C	0.408				✓				
MC42	A	0.668					✓			
MC43	D	0.580		✓						✓
MC44	C	0.604					✓			
MC45	D	0.425				✓				
MC46	D	0.884				✓			✓	
NR8	0.50	0.488				✓			✓	
MC47	D	0.648					✓			✓
MC48	C	0.738					✓			✓
WR1		0.530	✓	✓	✓	✓		✓	✓	✓
WR2		0.530		✓	✓		✓	✓		✓

Subtest: Multiple Choice and Numerical Response

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Multiple choice and numerical response: 37.7 out of 56

General Learner Expectations

GLE 1	Nervous & Endocrine Systems	11.2	out of	17
GLE 2	Reproductive Systems & Hormones	5.7	out of	8
GLE 3	Differentiation & Development	4.7	out of	7
GLE 4	Cell Division & Mendelian Genetics	8.3	out of	13
GLE 5	Molecular Genetics	2.6	out of	4
GLE 6	Population Genetics & Interaction	5.2	out of	7
Skills		10.4	out of	15
STS		9.4	out of	14

Multiple choice: 32.5 out of 48

Numerical response: 5.1 out of 8

Subtest: Written Response

Results are in average raw scores.

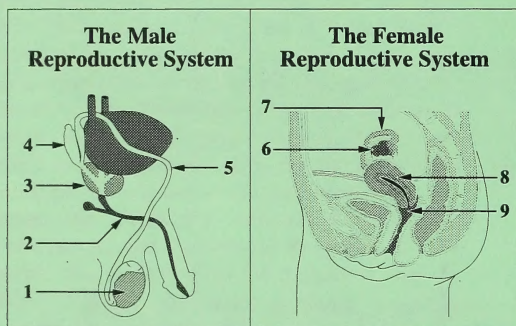
- Written Response: 12.5 out of 24
- Question 1: 6.6 out of 12
- Question 2: 5.9 out of 12

More than 4 000 Gulf War veterans complain of illness (Gulf War Syndrome). The veterans' symptoms include joint pain, shortness of breath, attention and memory problems, and chronic fatigue. During the war, most of the veterans took anti-nerve-gas pills. These pills contain pyridostigmine bromide, a drug that inhibits cholinesterase.

Pyridostigmine bromide is also used to treat patients with *myasthenia gravis*, an inherited disorder characterized by weakness of skeletal muscles.

13. In *myasthenia gravis*, a malfunction of neuromuscular synapses occurs. The information presented above indicates that the muscular weakness associated with this disorder occurs because

- A. axons secrete excess acetylcholine
- B. axons secrete insufficient acetylcholine
- C. of increased permeability of membranes to sodium ions
- D. of decreased permeability of membranes to potassium ions



Numerical Response

- I. Provide the number of the reproductive structure that is directly affected by each technology named below.

(Record your four-digit answer in the numerical-response section of the answer sheet.)

Reproductive
Structure:

Technology:	Vasectomy	Tubal ligation	Castration	Use of an intrauterine device (IUD)
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Answer: 5718

Multiple-choice question 13 required the students to analyze the function of the treatment pyridostigmine bromide to determine that the malfunctions due to *myasthenia gravis* are a result of the secretion of insufficient acetylcholine. With the provided information (that pyridostigmine bromide inhibits cholinesterase), most students achieving the standard of excellence (95.9%) correctly selected alternative B for question 11, thereby demonstrating that they understood that cholinesterase promotes the breakdown of a neurotransmitter. However, in question 13, only 66.8% of the students achieving the standard of excellence were able to link the inhibiting action of pyridostigmine bromide with the undersecretion of acetylcholine. Overall, 50.6% of the students were able to correctly answer this question.

Numerical-response question 1 required students to identify which reproductive structure was affected by four different technologies. An analysis of the responses indicated that the majority (90.6%) of students knew that the oviducts are affected by tubal ligation, 86.1% of the students knew that the testes are affected by castration, and 84.6% of the students knew that the vas deferens are affected by a vasectomy. One misconception was revealed. About 31.5% of the students thought that an IUD was placed at the outside of the uterus, in the vagina. Of the students who achieved the standard of excellence, 73.0% correctly identified the four reproductive structures affected by the given technologies.

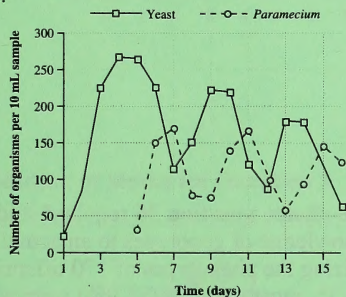
Which statement provides the best explanation for the underlying cause of the sex ratio at conception?

- A. Sperm that contain an X chromosome are more motile than those that contain a Y chromosome.
- B. Sperm that contain a Y chromosome are more motile than those that contain an X chromosome.
- C. There is a greater probability that males will produce sperm that contain an X chromosome than those that contain a Y chromosome.
- D. There is a greater probability that males will produce sperm that contain a Y chromosome than those that contain an X chromosome.

Multiple-choice question 21 required the students to identify the cause of the 1.6-to-1, male-to-female ratio at conception. While 43.0% of the students correctly selected alternative B, 39.9% selected alternative D. The students choosing D mistakenly think males produce more Y-containing sperm than X-containing sperm, while the ratio of these 2 different sperm is actually 1:1. Even a large proportion (28.4%) of the students who achieved the standard of excellence on the examination exhibited this misunderstanding.

Populations of Yeast and *Paramecium*

A suspension of yeast cells was added to a sucrose solution (nutrient medium) and incubated at 25°C for 16 days. On the fifth day, a small culture of the ciliate *Paramecium* was added. Each day, a 10 mL sample was withdrawn, the number of organisms present was determined, and the sample was returned to the mixture. The data collected were recorded on the following graph.

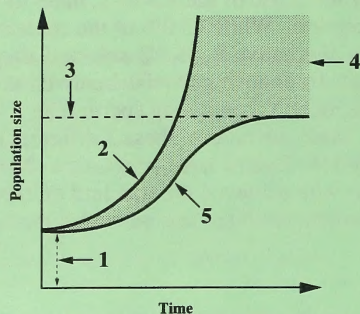


Multiple-choice question 32 required the students to select factors that affected the population of yeast over twelve days. In question 33, 82.7% of the students understood that the yeast population increased over two days because the *Paramecium* population decreased. However, 41.9% of the students incorrectly chose alternative C, demonstrating that they did not understand the nutritional relationship between yeast and *Paramecium*. Overall, only 48.9% of the students understood that *Paramecium* are predators of yeast.

The two factors that were likely responsible for the fluctuations in the population of yeast from day 4 to day 16 were

- A. predation and limited food supply
- B. temperature intolerance and predation
- C. limited food supply and overcrowding
- D. overcrowding and temperature intolerance

Hypothetical Population Growth Curves



Numerical Response

6. Select the set of four numbers from the graph that correctly completes the following statement.

Plotting uncontrolled, rapid population growth results in the curve labelled _____. However, the effect of environmental resistance, labelled _____ normally limits growth, resulting in the curve labelled _____. The population size becomes stable when the carrying capacity, labelled _____, is reached.

(Record your four-digit answer in the numerical-response section of the answer sheet.)

Answer: 2453

In *Drosophila*, ebony body colour is caused by the recessive allele *eb* and grey body colour by the dominant allele *eb*⁺. Vestigial wings are produced by the recessive allele *vg* and long wings by the dominant allele *vg*⁺.

When mated, a female with ebony body colour and vestigial wings produced the following offspring:

- 41 flies with ebony body and long wings
- 44 flies with grey body and long wings
- 39 flies with grey body and vestigial wings
- 46 flies with ebony body and vestigial wings

36. How many of the 44 offspring with grey bodies and long wings would be expected to be heterozygous for body colour?

- A. 44
- B. 33
- C. 22
- D. 11

45. Which observation correctly accounts for the fact that mitochondrial DNA is passed on only from mother to child?

- A. Eggs contain mitochondria and sperm do not.
- B. Mitochondrial DNA is transcribed from a template on the XY chromosome set.
- C. Mitochondrial DNA is transcribed from a template on the XX chromosome set.
- D. An egg contributes both its nucleus and its cytoplasm to a zygote, while a sperm contributes only its nucleus.

Numerical-response question 6 required the students to identify the parts of a hypothetical population growth curve. The majority of the students, 94.6%, 93.3%, and 86.7% respectively, correctly answered the questions about the J-shaped population growth curve, sigmoid-shaped population growth curve, and the carrying capacity of a population. However, only 61.9% correctly identified environmental resistance as area 4 on the graph. About 16.0% thought it was area 1, and about 16.4% identified it as area 3.

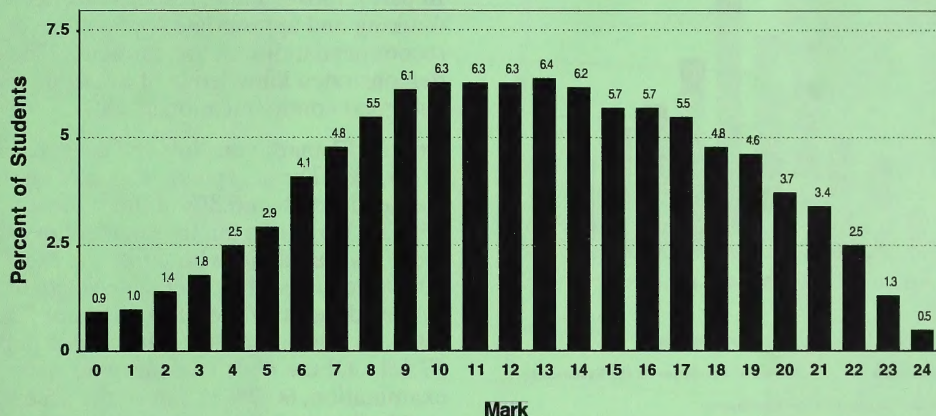
Multiple-choice question 36 required students to apply knowledge of genotypes to an actual data set summarizing the phenotypes of 170 offspring. In question 35, most students (86.9%) were able to select the correct genotype for the male parent from his phenotype. However, only 44.7% of the students were able to correctly select the number of offspring produced with a given genotype, as was asked in question 36. This question was answered correctly by 75.1% of the students who achieved the standard of excellence on the examination, whereas 97.0% of these students answered question 35 correctly.

Multiple-choice question 45 required students to choose evidence for maternal mitochondrial DNA. Only 41.7% of the students demonstrated sufficient knowledge of the structure of the egg and sperm cells to correctly select alternative D, while 39.0% of the students selected alternative C. This alternative is an explanation, although incorrect, and not an observation, as was requested. This question was answered correctly by 61.9% of the students who achieved the standard of excellence on the examination.

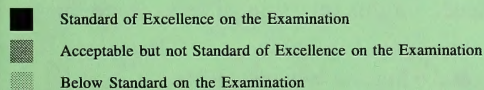
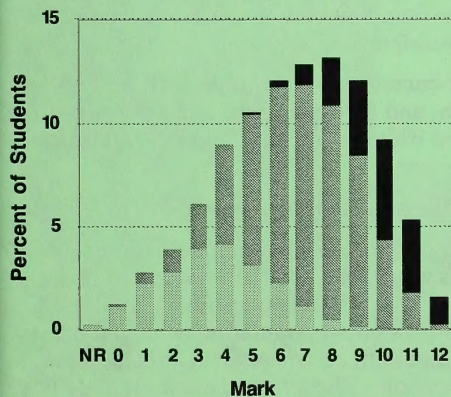
Written-Response Questions

Responses to the written-response questions indicated that most students approached the examination seriously. Of the students who wrote the examination, 0.9% received no marks for both written-response questions, 56.4% received 12 marks or more out of 24, and 11.4% received 20 marks or more out of 24.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1: This process skill question, which related to a case study of two families that have members who inherited myotonic dystrophy, was attempted by almost all students (99.7%) who wrote the examination.

Most subparts of the question required students to analyze data and then provide hypotheses, predictions, evidence, and inferences about possible offspring from a pending marriage.

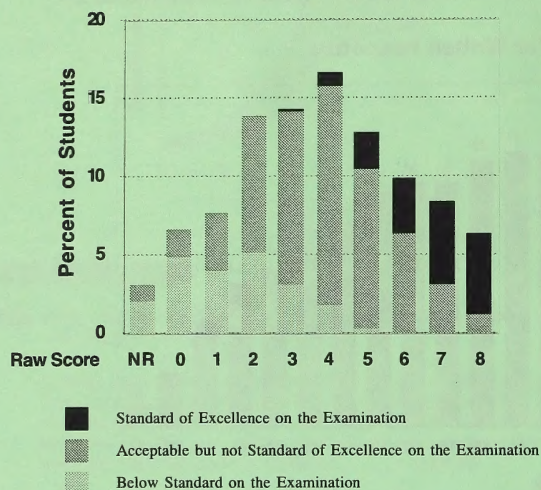
In part *a*, about half of the students made the connection between frequency of myotonic dystrophy and reproductive isolation.

In part *b*, most students understood how to draw a pedigree; however, many students did not use the data sheets, which was demonstrated by their omission of birth order and numbering details on their pedigree.

In part *c*, many students had difficulty with the term "mode of inheritance." However, those that did understand used the data well as evidence for sex-linked inheritance. Few students considered this condition to be inherited autosomally.

In part *d*, many students based their prediction for the possible offspring on the assumption that the potential mother was a carrier. Very few students considered that the mother may not have been a carrier, and, therefore, did not combine the two possible probabilities.

Distribution of Marks for Question 2



In part *e*, many students focused on the usefulness of the pedigree in predicting whether or not the offspring will inherit myotonic dystrophy, rather than on the severity of the condition, as they should have. This demonstrates that the majority of the students read the presented data poorly.

In part *f*, most student responses reflected sound thinking and appropriate applications of recommendations and/or cautions. They demonstrated knowledge of available technologies and good communication skills.

On this 12-mark question, the average mark was 6.6 or 55.3%. The acceptable standard on this question was achieved by 66.3% of the student population, with 16.1% achieving the standard of excellence. Of the female students who wrote the examination, 70.3% achieved the acceptable standard and 17.9% achieved the standard of excellence. The average mark on this question for the female population was 57.6%. Of the male students who wrote the examination, 60.7% achieved the acceptable standard and 13.7% achieved the standard of excellence. The average mark on this question for the male population was 51.9%.

Question 2: This extended-response question was attempted by 96.8% of the students who wrote the examination. The question required students to explain how the development of drug-resistant bacteria is related to its DNA and its *r*-selected nature. Students were asked to describe how two other technologies have also caused unanticipated environmental, health, or societal problems.

Many students demonstrated knowledge of the *r*-selected nature of bacteria and of problematic technologies. However, few students focused on the DNA portion of the question, and few linked the technology portion of the question to the problems their use created. Students confused bacteria, viruses, and DNA, immunity and resistance, and antibodies and antibiotics.

Organizational and communication skills were evident in many of the students' responses.

This question was marked holistically. Two markers read each response and each assigned a score from 0 to 4. These scores were added to obtain a raw score from 0 to 8. This raw score was then converted to a mark out of 12. On this 12-mark question, the average mark was 5.9 or 47.3%. On this question, 54.1% of the student population achieved the acceptable standard, and 14.7% of the student population achieved the standard of excellence. Of the female students who wrote the examination, 53.6% achieved the acceptable standard, and 14.9% achieved the standard of excellence on this question. The average mark on this question for the female population was 47.3%. Of the male students who wrote the examination, 54.8% achieved the acceptable standard, and 14.4% achieved the standard of excellence on this question. The average mark on this question for the male population was 47.2%.

For further information, contact Karen Slevinsky or Yvonne Johnson at the Student Evaluation Branch, 403-427-0010.

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